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(54) Corrugated tube

(57) A corrugated tube (40) has a ridge shape (12) and a trough shape (13), viewed on an axial cross-section thereof, alternating along its axial direction. The tube also has a slit (30) along its axial direction thereby forming first and second zones flanking the slit. The first and second zones comprise a first (12a) and a second end portion (12b) of the ridge shapes (12), respectively. The first end portion (12a) forms a convex portion (31), whilst the second end portion (12b) forms a sequential convex (32) and concave portion (33). Each portion extends from the slit (30) side around the opposing circumferential directions, thereby forming female (44) and male locking means (49) respectively. when the male locking means (49) are inserted under the female locking means (44), the convex portion (31) of the first zone and the sequential convex (32) and concave portion (33) of the second zone are stacked and the slit (30) is firmly locked

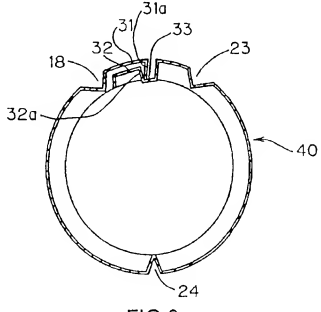

FIG.9

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Description

The present invention relates to a corrugated tube for containing and protecting a wiring harness, e.g. in motor vehicles such as automobiles. More particularly, the invention concerns a corrugated tube having a longitudinal slit along its axial direction. A wiring harness is composed of a plurality of electrical wires. In the construction according to the present invention, the slit is first opened and the wiring harness is inserted into the corrugated tube sideways through this slit. Further, once the harness is inserted, the slit is firmly closed in an easy manner.

In a wiring harness used for automobiles, some portions thereof, where necessary, are wrapped in a corrugated tube and thus protected. Examples of known corrugated tubes for such applications include:

- tubes having a slit along their axial direction (type 1-1), shown in Fig. 1 A
- tubes having no slit (type 1-2), shown in Fig. 1 B
- tubes similar to those of type 1-1 but further having zones R which are overlapped in the circumferential direction of the tube (type 1-3), shown in Fig. 1 C.

In the case of corrugated tube 1-2 without slit, when a connector housing is initially mounted on an end portion of the electrical wires W, the latter cannot be passed through the corrugated tube 1-2. Therefore, the electrical wires must first be placed in the corrugated tube 1-2 and only then can the connector housing be mounted on the end portion of the wires. When the connector housing is subsequently mounted, the end portion of each electrical wire cannot be inserted thereinto by an automated process. Consequently, the automation of the assembly process becomes difficult.

In the case of corrugated tube 1-1 with a slit, a group of electrical wires W is inserted by opening the slit. The connector housing can thus be mounted onto the end portion of the electrical wires beforehand. Accordingly, an automated process can be envisaged for inserting the end portion into the connector housing. However, when the zone protected by the corrugated tube is bent as illustrated in Fig. 2, the slit may be opened. It is therefore necessary to lock the slit, once the electrical wires W have been inserted. To this end, a tape can be wound around the outer circular surface of the tube 1-1. However, this task is cumbersome.

A corrugated tube 1-3 with an overlap-type slit, shown in Fig. 1 C, differs from the above, solely in that the overlapping zone on one side of the slit is superposed on a corresponding zone of the other side of the slit. Nevertheless, it is still necessary to use tape in order to lock the slit securely. As mentioned, this task is cumbersome.

There is also known a corrugated tube having a ridge shape and a trough shape, viewed on an axial cross-section, alternatingly provided throughout the axial direction, and having a slit all along the axial direction. The slit defines first and second zones therealong: the first zone comprising a first end portion of the ridge shapes and the second zone comprising a second end portion of the ridge shapes. The first and second end portions are further provided with a first and a second sequences having a repeating unit of concave and convex portions, viewed from the axial direction of the tube. The first and second sequences extend respectively from the slit along the opposing circumferential directions of the tube, thereby forming female and male locking means respectively. In this construction, the male locking means are inserted under the female locking means, whereby the first and second sequences are fittingly stacked and the slit is locked in a closed state.

In this construction, the female locking means may have a width, measured along the axial direction, greater than the width of the male locking means.

Also, the female locking means may comprise, starting from the slit side, an L-shaped convex, a concave and a convex sequence, when viewed on a lateral cross-section, whilst the male locking means may comprise an inverted-V shaped convex, a concave and a convex sequence. After the slit is opened and the electrical wires are inserted into the tube, the female locking means and the male locking means are fitted, whereby the slit is locked in a closed state.

An object of the present invention is to remedy the above-mentioned drawbacks, and to supply means to automatically insert an electrical terminal into a connector housing and lock the slit by one single operation, thereby suppressing the taping work.

To this end, there is provided a corrugated tube having a ridge shape and a trough shape, viewed on an axial cross-section thereof, alternatingly provided throughout the axial direction thereof, and having a slit throughout the axial direction, the slit defining a first and a second zone respectively including a first and a second end portion of the ridge shapes, the first end portion comprising a convex portion having a cross-section of inverted-U section, viewed from the axial direction, the convex portion extending from the slit side around a first circumferential direction of the tube, thereby forming female locking means, the second end portion comprising a sequence of a convex portion having a cross-section of inverted-U section and a concave portion, the sequence extending from the slit side around a second circumferential direction of the tube, opposed to the first circumferential direction, thereby forming male locking means, the female locking means being superposed on the male locking means, whereby the slit is locked in a closed state.

Preferably, the female locking means have a width, measured along said axial direction of the tube, greater than the width of the male locking means. Still preferably, the convex portion of the female locking means has a length, measured around the circumferential direction of the tube, greater than the length of the convex portion

of the male locking means.

Further, the convex portion of the female locking means may comprise an outermost side wall having an inner face, viewed from the axis of the tube whilst the convex portion of the male locking means may comprise a side wall, the side wall being shared with the concave portion thereof and having an outer face, viewed from the axis of the tube, the inner face of the female locking means and the outer face of the male locking means extending in a substantially diametrical direction, and wherein the inner face has a height, measured along the diametrical direction, equal to, or greater than, that of the outer face.

The present invention includes also a corrugated tube comprising a wiring harness composed of electrical wires. In this embodiment, the electrical wires are inserted into the tube after opening the slit and the female locking means are superposed on the male locking means, whereby the slit is locked in a closed state.

In the aforementioned embodiments, the female locking means, formed on one side of the slit, is covered on the male locking means, formed on the other side thereof, such that the convex portion of the former is superposed on the outer surface of the convex portion of the latter. Also, the convex portion of the former has a diametrically lifting wall, viewed from the axial direction, adjacent to the slit, as well as a diametrically inward-looking wall-end. When applied, the wall-end is fitted into the concave portion of the male locking means. At the same time, it is abutted against a diametrically lifting, outside-facing surface of the convex portion of the male locking means. In this manner, the slit is closed and locked by one press-fit operation. Thus, taping work can be suppressed.

Further, the female locking means have a width, measured along the axial direction of the tube, greater than that of the male locking means. By virtue of this configuration, the male locking means can be easily inserted under the female locking means, relative to the axis of the tube.

As has been seen above, the electrical wires, which constitute a wiring harness, are inserted into the tube by opening the slit, the female locking means are overlapped to the male locking means, and the slit is locked in a closed state.

Also, the stacked concave portions are interposed between the stacked convex portions, so that the slit is securely locked.

This sequential action is very simple and the slit is closed and locked by a single press-fit operation. The after-taping is thus no longer needed. Further, only the ridge portions, and not the trough portions, lock the corrugated tube. This structure allows the tube to retain flexibility. By virtue of this flexibility, the electrical wires can be easily bent and cabled along a vehicle.

The above and other objects, features and advantages of the present invention will become apparent from the following description of the preferred embodiments, given as a non-limiting example, with reference to the accompanying drawings, in which

Fig. 1 A shows a known corrugated tube with a slit;

Fig. 1 B shows a known corrugated tube without a slit;

Fig. 1 C shows a known corrugated tube with a slit and overlapping zones;

Fig. 2 illustrates a known corrugated tube when slit thereof is unlocked by a bending force;

Fig. 3 A is a lateral cross-sectional view of a corrugated tube;

Fig. 3 B is a perspective view of the corrugated tube shown in Fig. 3 A;

Fig. 4 shows the corrugated tube of Fig. 3 when the slit is locked;

Fig. 5 shows a top plan view on the locking means of the corrugated tube of Fig. 3;

Fig. 6 A is a perspective view of the tube shown in Fig. 3 during its manufacturing process;

Fig. 6 B is a cross-sectional view of the tube shown in Fig. 3 when installed in a holding device before cutting;

Figs. 7 A and B show a view on a lateral cross-section of the corrugated tube of Fig. 3 when loaded with electrical wires, respectively before and after locking;

Figs. 8 A and B show a view on a lateral cross-section and a perspective view respectively, of the corrugated tube according to the invention;

Fig. 9 shows a view on a lateral cross-section of the corrugated tube of Fig. 8;

Fig. 10 shows a top plan view on the locking means of the corrugated tube of Fig. 8; and,

Figs. 11 A and B show a view on a lateral cross-section of the corrugated tube of Fig. 8 when loaded with electrical wires, respectively before and after locking.

For a better understanding of the invention, an embodiment already described in a previous application, but not yet published, will be described hereinafter.

In the embodiment shown in Figs. 3A and 3B, the corrugated tube 10 has a slit 11 extending all along an axial direction L. In addition, a circular ridge shape 12 and a circular trough shape 13 are alternatingly provided at a predetennined pitch along the axial direction.

First and second zones are provided along the slit 11 at respective sides thereof. These zones include the part 12a, 12b of all the ridge shapes 12 adjacent to the slit 11. This part of the ridge shapes is provided with a concave and convex shape, viewed from a lateral cross-section around the circular direction. The convex and concave portions can be superposed on each other by one press-fit operation, thereby closing the slit 11.

Part 12a of the first zone constitutes female locking means 14. The latter comprises, sequentially from the slit side and around the circular direction, end convex

portion 15 having an open end and an L-shaped cross-section, a concave portion 16, a convex portion 17 and a concave positioning groove 18, used for positioning the tube when cutting (see Fig. 4). Part 12b constitutes male locking means 19. The latter comprises, in a same manner, a convex portion 20 having an inverted V-shaped cross-section, a concave portion 21, a convex portion 22 and a concave positioning groove 23, used for positioning the tube when cutting.

As shown in Fig. 5, the female locking means 14 (end convex portion 15, concave portion 16 and convex portion 17) have a width W 1, measured in the axial direction, which is broader than the width W 2 of the male locking means 19 (convex portion 20, concave portion 21 and convex portion 22), i.e. W 1 > W 2. Thus, the male locking means 19 can be set inside the female locking means 14, viewed on the cross-section of the tube. Further, a substantially V-shaped notch 24 is formed at a position diametrically opposed to that of the slit 11. Moreover, the concave portion 21 of the male locking means 19 has a length L 2, measured around the circular direction, greater than that L 1 of the concave portion 16 of the female locking means 14, i.e. L 1 < L 2.

As shown in Figs. 6A and 6B, the corrugated tube 10 is initially manufactured in a cylindrical shape, such that the end convex portion 15 of the female locking means 14 has an edge connected to that of the end convex portion 20 of the male locking means 1 via a diametrically extending wall 25. This connecting wall 25 is cut by a cutter 27, thereby forming a slit 11 with its female locking means 14 and male locking means 19 separated by this slit. The tube has a concave positioning groove 18, 23 provided on each side of the slit 11. When using the cutter 27, the tube is placed in a holding device 28 having a pair of holding ribs 29 and maintained in the device by fitting the ribs 29 into the corresponding concave portions 18, 23.

In the above tube with a slit 11, the connector housing (not shown in the figures) is first connected to the end of the electrical wires W. The slit 11 of the corrugated tube 10 is then opened, as illustrated in Fig. 7A, and the wires W are inserted therethrough into the tube.

The female and the male locking means 14, 19, flanking the slit 11, are then brought closer together and the male locking means 19 are brought under the female locking means 14, as shown in Fig. 7B. As the tube is provided with a V-shaped notch 24 at a position diametrically opposed to the slit 11, the male and female locking means are smoothly moved closer and overlapped.

The V-shaped end convex portion 20 of the male locking means 19 is first brought under the L-shaped end convex portion 15 of the female locking means 14. The end convex portion 20 is advanced beyond the concave portion 16 and fitted into the convex portion 17. At the same time, the concave portion 21 of the male locking means 19 is tightly superposed to the concave portion 16 of the female locking means 14. Likewise, the convex portion 22 of the male locking means 19 is superposed to the end convex portion 15 of the female locking means 14.

Consequently, three sequential concave and convex portions of the female locking means 14 are fitted onto the three sequential concave and convex portions of the male locking means 19. In particular, the fitted concave portions 16, 21 are sandwiched between two stacked convex portions. Moreover, this type of fixture is effected for all the ridge shapes along the axial direction of the corrugated tube 10. For this reason, the both locking means 14, 19 are securely locked and the slit 11 is tightly closed. As the result, the taping work, hitherto necessary for preventing the slit opening, can be suppressed.

Compared to the above, the corrugated tube 40, according to the present invention, has a simpler structure.

As shown in Figs. 8A and 8B, the corrugated tube 40 comprises a slit 30 extending throughout an axial direction L of the tube 40. Also, a circular ridge shape 12 and a circular trough shape 13 are alternatingly arranged at a predetermined pitch along the axial direction.

The above slit 30 divides the tube in the longitudinal direction and forms first and second zones on the rim thereof. The first zone comprises part 12a of the ridge shapes adjacent to the slit 30 and constitutes female locking means 44. Likewise, the second zone comprises part 12b of the ridge shapes adjacent to the slit 30 and constitutes male locking means 49. The slit 30 can be closed and locked by one press-fit operation.

The part of the ridge shapes 12a (female locking means 44) forms a convex portion 31 having an inverted-U shape, viewed from a lateral cross-section, extending from the slit side around the circular direction. At a position adjacent to the convex portion 31 is provided a concave positioning groove 18, used for fixing the tube before cutting. The part of the ridge shapes 12b (male locking means 49) comprises, sequentially as viewed from the slit side around the circular direction, a convex portion 32 having an inverted-U shape and a concave portion 33. At a position adjacent to the latter is provided a concave positioning groove 23, used for fixing the tube before cutting.

As shown in Fig. 10, the convex portion 31 of the female locking means 44 has a width W 3, measured along the axial direction, greater than the width W 4 of the convex and concave portions 32, 33 of the male locking means 49, i.e. W 3 > W 4. In addition, the length L 3 of the former 31 is designed to be greater than the length L 4 of the convex portion 32 of the male locking means 49, i.e. L 3 > L 4. Thus, the former can contains the latter and both can be properly superposed.

As shown in Fig. 9, the height of the internal face of the side wall 31a contained in the convex portion 31 of the female locking means 44 is equal to, or greater than, the height of the external face of the side wall 32a contained in the convex portion 32 of the male locking

means 49. Thus, the edge of the side wall of the convex portion 31 in the female locking means 44 is abutted against the base of the concave portion 33 in the male locking means 49.

Such a corrugated tube 40 is initially formed in a cylindrical form, such that the wall edge of the convex portion 31 in the female locking means 44 and the wall edge of the convex portion 32 in the male locking means 49 are positioned adjacent to each other and integrally formed. As in the case of the corrugated tube 10 shown in Fig. 4 B, the tube 40 is placed in the holding device 28, such that the concave positioning grooves 18, 23 are snapped with the corresponding ribs 29.

The line corresponding to the wall edge of the convex portion 31 in the female locking means 44 and of the convex portion 32 in the male locking means 49 is then cut by a cutter 27, so that there is formed a slit 30, with its female locking means 44 and male locking means 49 separated by this slit.

As mentioned above, the corrugated tube 40 according to the invention is provided with a slit 30. The connector housing (not shown in the figures) can therefore be equipped to the end of the electrical wires beforehand. The tube 40 is then inserted with the wires by opening the slit 30 as shown in Fig. 11 A.

Subsequently, the first zone extending along one side of the slit 30 of the tube 40 is lifted up from the group of the wires W and placed upon the corresponding second zone. In this way, the part of the ridge shapes 12a of the female locking means 44 is superposed on the corresponding part of the ridge shapes 12b of the male locking means 49, located on the other side of the slit 30. Accordingly, the convex portion 31 contained in the part 12a of the female locking means 44 is overlapped to the convex portion 32 contained in the part 12b of the male locking means 49 throughout the slit 30. Also, as shown in Fig. 11 B, the side wall 31a of the female-side convex portion 31 is engaged with the side wall 32a of the male-side convex portion 32 in the adjacent concave portion 33. In this way, the slit 30 can be locked by one single operation and the tape-winding task to ensure the closure of the slit can be suppressed. Moreover, the internal depth of the side wall 31a of the convex portion 31 is arranged to be equal to, or greater than, the external depth of the side wall 32a of the convex portion 32, so that the wall edge of the side wall 31a is anchored on the base of the male-side concave portion 33. This structure ensures a constant clamping force.

In the corrugated tube 40 according to the invention, the number of concave and convex portions, formed on the ridge shapes, can be reduced compared to the prior art. Therefore, the above-mentioned technique is easily applicable to a small-diameter corrugated tube, for which the integration of locking means is usually difficult.

However, the object of the present invention is not limited to the above-mentioned embodiments. The locking means may be formed on just some of the ridge shapes 12 located at both end regions in the axial direction of the tube instead of being installed throughout the axial direction thereof. Also, the pitch of the ridge shapes may be varied and appropriately spaced.

Further, the corrugated tube is manufactured in a cylindrical form. By simply cutting the tube, a slit can be formed together with the female and male locking means. The invention can therefore be put into practice very easily.

Claims

1. The corrugated tube (40) having a ridge shape (12) and a trough shape (13), viewed from an axial cross-section thereof, alternatingly provided throughout an axial direction thereof, and having a slit (30) throughout said axial direction, said slit (30) defining a first and a second zone respectively including a first (12a) and a second end portion (12b) of said ridge shapes (12), characterised in that said first end portion (12a) comprises a convex portion (31) having a cross-section forming an inverted-U shape, as viewed from said axial direction, said convex portion (31) extending from said slit (30) side around a first circumferential direction of said tube, thereby forming female locking means (44), in that said second end portion (12b) comprises a sequence of a convex portion (32) having a cross-section forming an inverted-U shape, and a concave portion (33), said sequence extending from said slit side around a second circumferential direction of said tube, opposed to said first circumferential direction, thereby forming male locking means (49), and in that said female locking means (44) are stackable on said male locking means (49), whereby said slit (30) can be locked in a closed state.

2. The corrugated tube (40) according to claim 1, wherein said female locking means (44) have a width (W 3), measured along said axial direction of said tube (40), greater than the width (W 4) of said male locking means (49).

3. The corrugated tube (40) according to claim 1 or 2, wherein said convex portion (31) of said female locking means (44) has a length (L 3), measured around said circumferential direction of said tube (30), greater than the length (L4) of said convex portion (32) of said male locking means (49).

4. The corrugated tube (40) according to any one of claims 1 to 3, wherein said convex portion (31) of said female locking means (44) comprises an outermost side wall (31a) having an inner face, viewed from said axis of said tube (40), whilst said convex portion (32) of said male locking means (49) comprises a side wall (32a), said side wall (32a) being shared with said concave portion thereof and hav-

ing an outer face, viewed from said axis of said tube (30), said inner face of said female locking means (44) and said outer face of said male locking means (49) extending in a substantially diametrical direction, and wherein said inner face has a height, measured along said diametrical direction, equal to, or greater than, that of said outer face

5. The corrugated tube (40) according to any one of claims 1 to 4, wherein said corrugated tube (40) comprises a wiring harness (W) composed of electrical wires, said wires (W) being inserted into said tube (40) after opening said slit (30) and said female locking means (44) are superposed on said male locking means (49) whereby said slit (30) is locked in a closed state

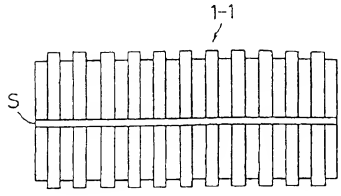

FIG.1A

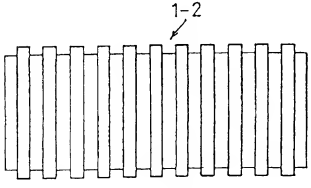

FIG.1B

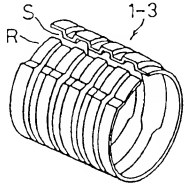

FIG.1C

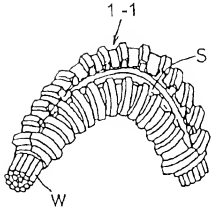

FIG.2

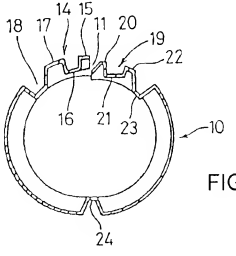

FIG.3A

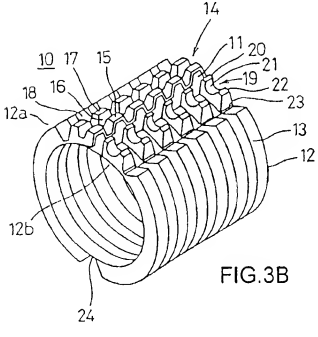

FIG.3B

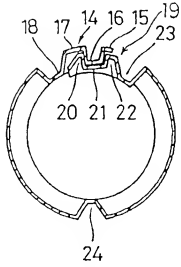
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FIG.4

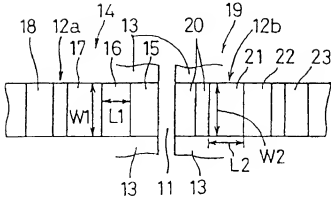
14
18
12a
13
20
19
12b
17
16
15
21
22
23
W1
L1
W2
L2
13
11
13

FIG.5

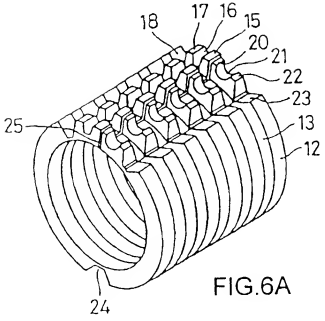
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FIG.6A

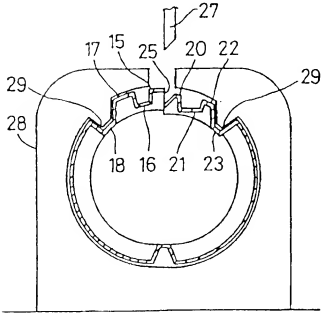
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FIG.6B

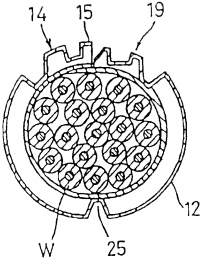


FIG.7A

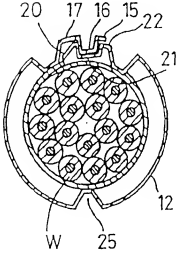


FIG.7B

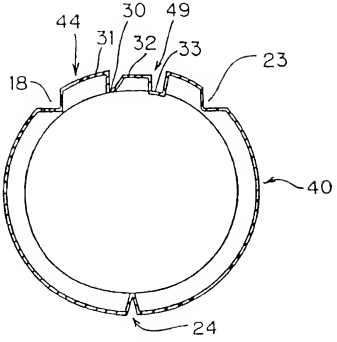


FIG.8A

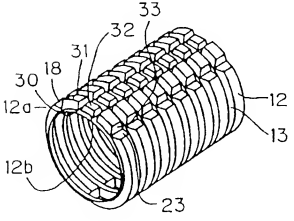
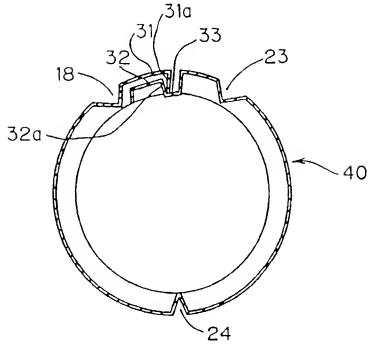


FIG.8B


31a
31
33
32
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32a
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24

FIG.9

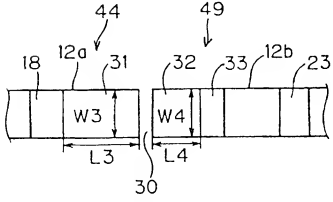
44
49
18
12a
31
32
33
12b
23
W3
W4
L3
L4
30

FIG.10

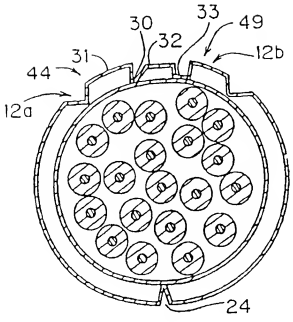

FIG.11A

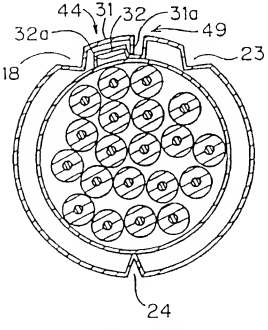

FIG.11B

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 40 0414

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl.6)
Y	WO 94 11663 A (PROPRIETARY TECHNOLOGY INC ;BARTHOLOMEW DONALD DEKLE (US)) 26 May 1994 * claims 1,2,20; figure 6 *	1-4	H02G3/04
Y	US 4 513 787 A (HEGLER WILHELM ET AL) 30 April 1985 * column 1, line 40 - line 50; figures 1-6 *	1-4	
			TECHNICAL FIELDS SEARCHED (Int Cl.6) H02G F16L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	29 May 1998	Moueza, A

CATEGORY OF CITED DOCUMENTS

X particularly relevant if taken alone
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A technological background
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P intermediate document

T theory or principle underlying the invention
E earlier patent document, but published on, or after the filing date
D document cited in the application
L document cited for other reasons

& member of the same patent family, corresponding document

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